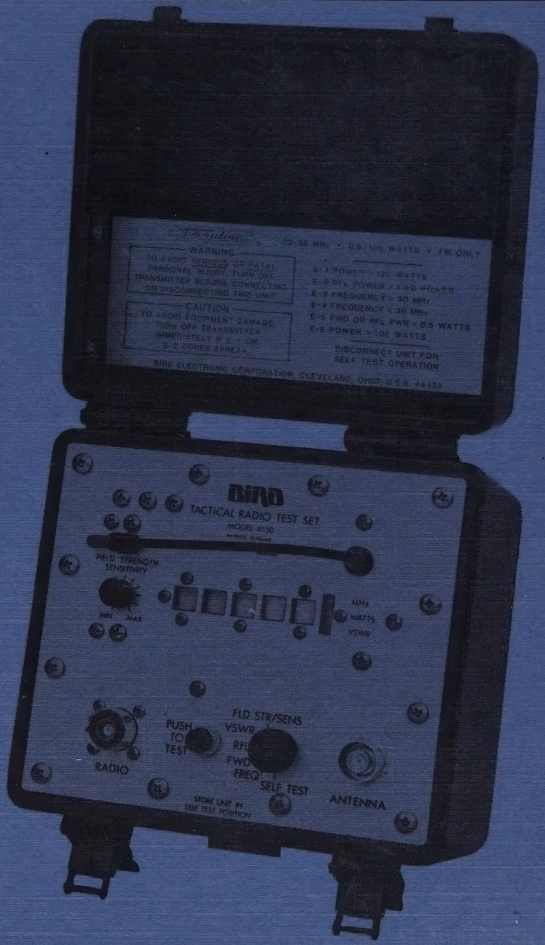
Operator's Manual

for

BIRD

Model 4130

TACTICAL RADIO TEST SET



WARNING

HIGH VOLTAGE
is present on the radio sets being tested.
DEATH ON CONTACT
or injury may result if personnel fail to observe safety precautions. Remove power from the equipment being tested before connecting or disconnecting the cables to the RADIO and ANTENNA Connectors of the Model 4130.

WARNING

Personnel can be seriously injured if the lithium Battery contained in the Model 4130 is not handled and disposed of properly. Always observe the following guidelines:

- Dispose of the Battery properly: never burn, crush or incinerate.
- Never attempt to recharge the Battery.
- Never bypass the fuse.
- If the Battery vents gas or becomes hot, stop operating the equipment. Do not handle the Battery until it cools and stops venting.

CAUTION

If either of the following error messages occurs:

- E-1, RF power greater than 120 watts;
- E-2, reflected power greater than or equal to forward power. (The ANTENNA and RADIO Connections are probably reversed.)

STOP TRANSMITTING IMMEDIATELY
Equipment failure of the Model 4130 and/or the radio set being tested can occur.

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CHAPTER 1

INTRODUCTION

1-1 INTRODUCTION. This manual provides information on the operation of the Model 4130 Tactical Radio Test Set produced by Bird Electronic Corporation. See Figure 1-1. The procedures are designed for a technician who has a knowledge of:

(a) Fundamental concepts of radio transmission and reception such as receiver sensitivity and selectivity

(b) The operation of the radio sets being tested

(c) The acceptable operating specifications of the radio sets being tested

The Model 4130 is designed to check the operational performance of FM VHF radio sets--such as the AN-VRC 12, 43 thru 49 series, AN/PRC-77, and AN/PRC-68--although most other FM radio sets operating in the frequency band from 30 to 90 megahertz can also be tested.

In addition to checking the operational performance of a single radio set, the Model 4130 can be used to "grade" the relative performance of a group of like radio sets. As the result, those radio sets with higher or more consistent actual operating ratings can be easily identified and, subsequently, used in the more critical applications. This is referred to as "tactical deployment." A typical example of tactical deployment is using radio sets with the best or most consistent selectivity, sensitivity and power output in the most remote field locations.

1-2 MANUAL ORGANIZATION. The organization of this Manual is as follows.

(a) Hardware description (Chapter 2)

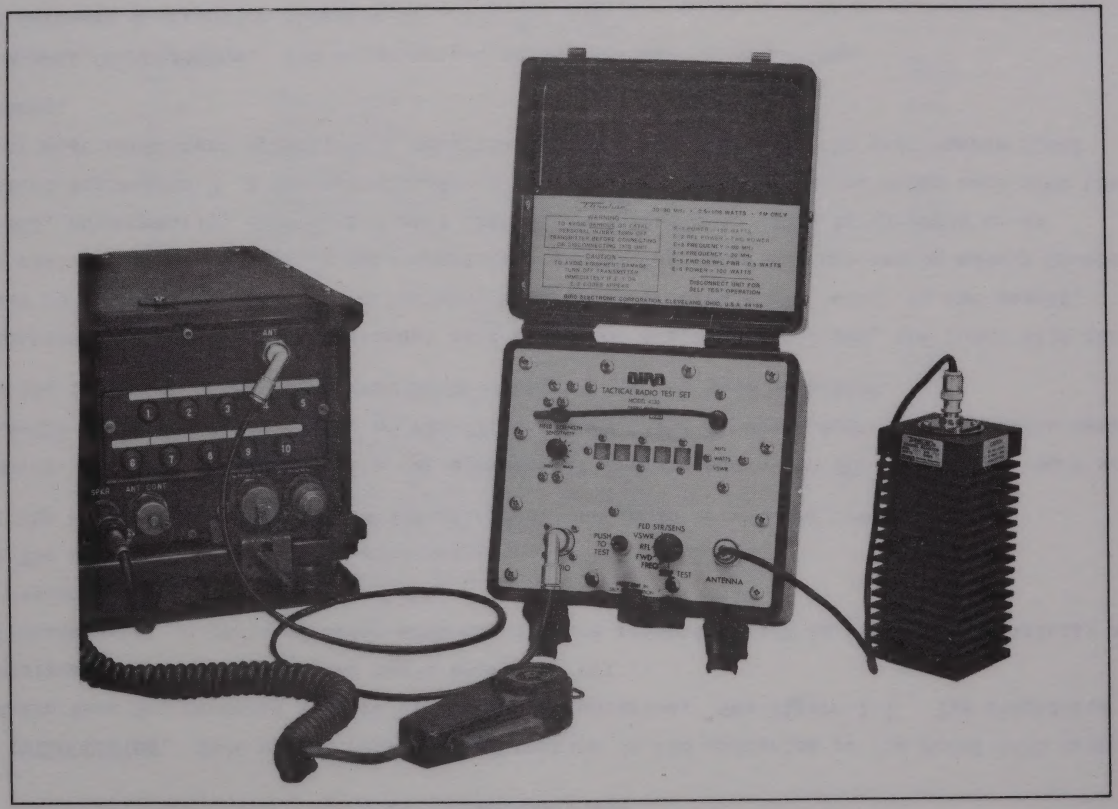

Figure 1-1 Model 4130 (with related equipment)

(b) Test setup, describing how to physically connect the Model 4130 to the radio sets (Chapter 3)

(c) Test function operations (Chapter 4)

(d) Battery replacement (Chapter 5)

(e) Specifications (Chapter 6)

(f) Error codes/low Battery indications (Chapter 7)

CHAPTER 2

MODEL 4130 DESCRIPTION

2-1 GENERAL. This Chapter describes the types of measurements performed by the Bird Model 4130 Tactical Radio Test Set. The Chapter should be read thoroughly and understood by the equipment operator before attempting to use the Model 4130.

2-2 FUNCTIONAL DESCRIPTION. The Model 4130 is a portable, self-contained instrument used to test FM tactical radios. This Section describes the specific test functions performed by the Model 4130. See Chapter 6 for a listing of specifications.

2-2.1 RF Measurements. The following types of RF measurements are performed when the Model 4130 is connected in-line between the transmitter and antenna:

(a) Forward RF power. Measured from 0.5 to 100 watts.

(b) Reflected RF power. Measured from 0.5 to 100 watts.

(c) Voltage Standing Wave Radio (VSWR). Automatically calculated using the forward and reflected power measurement data.

(d) Frequency. Measured from 30 to 90 MHz.

2-2.2 Sensitivity. The Model 4130 provides 13 output signals, 0.45 (±0.15) microvolt in amplitude, 1 at each even 5 MHz frequency in the range from 30 to 90 MHz; that is, one at 35 MHz, one at 40 MHz, etc. Each output signal is simultaneously frequency-modulated with both 1 kHz and 150 Hz tones. They are used to check the relative sensitivity and squelch operation of an FM receiver.

2-2.3 Relative Field Strength. A relative field strength measurement provides a means for peaking the transmitter-to-antenna coupling of hand-held transceivers. The Model 4130 receives the signal from a small antenna mounted on its Front Panel. The Display of the Model 4130 indicates the relative power received. By peaking the transmitter-to-antenna coupling, this relative power measurement will increase.

2-2.4 Self Test. A self-test function verifies that the Model 4130 is operational and also displays the unit's Battery voltage. This test should be performed when first using the instrument.

2-3 HARDWARE DESCRIPTION.

2-3.1 Case. The case of the Model 4130 is designed to withstand high altitudes, shock and even immersion. A relief valve, located on the front of the Case, provides automatic two-way pressure venting. See Figure 2-1.

2-3.2 Front Panel. The Connectors, various controls, and Display for the Model 4130 are located on the Front Panel. See Figure 2-1. The Front Panel is hermetically sealed so that the unit can be operated even in the rain. Each of the items contained on the Front Panel are described in the following Paragraphs.

2-3.2.1 Function Switch. The Function Switch provides the ability to select one of the following test functions:

(a) SELF TEST. Tests the Model 4130's circuitry for proper operation and displays the Battery voltage. Selecting this position at any time during testing stops testing and effectively turns off the Model 4130.

(b) FREQ. The frequency of the RF power being transmitted.

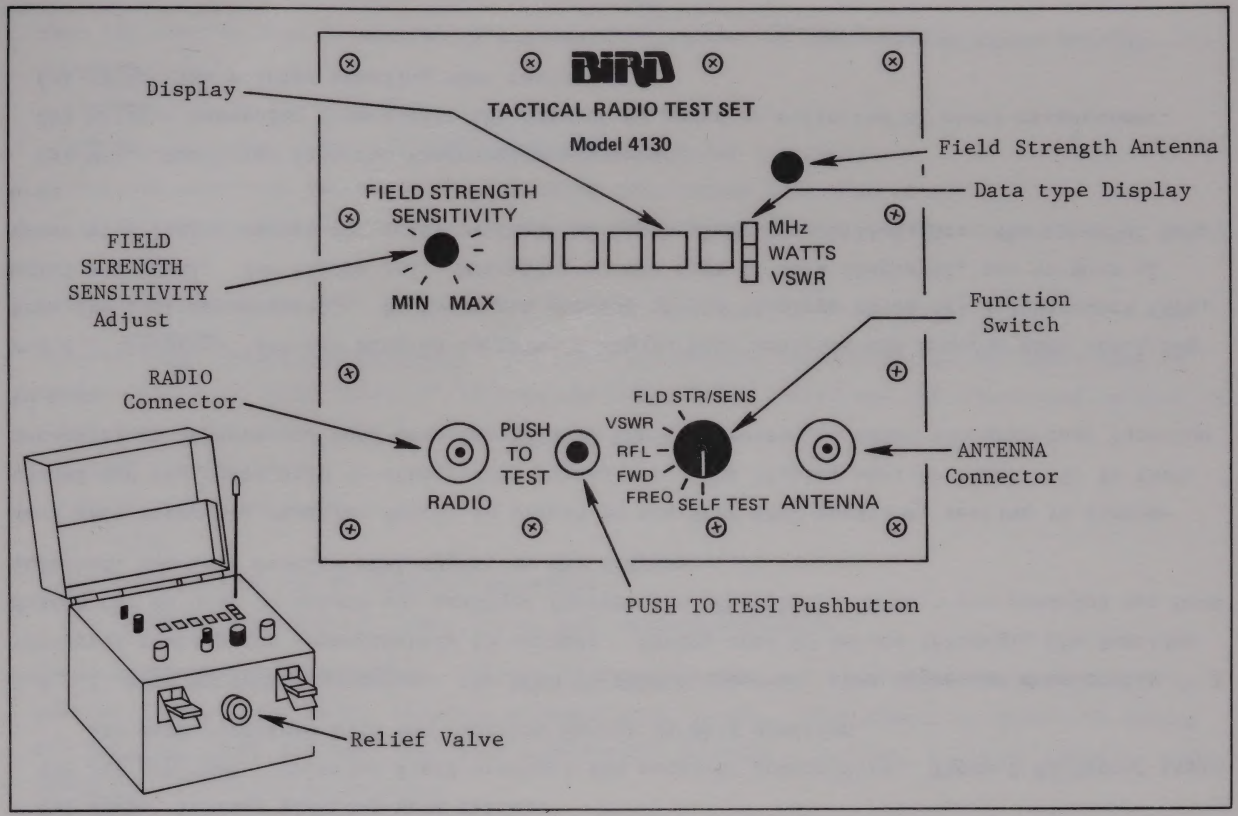

Figure 2-1 Model 4130

(c) FWD. Forward RF power.

(d) RFL. Reflected RF power.

(e) VSWR. Voltage standing wave ratio.

(b) FLD STR/SENS. Relative field strength and receiver sensitivity. These 2 different tests are both performed with the Function Switch in this position.

2-3.2.2 PUSH TO TEST Pushbutton. The PUSH TO TEST Pushbutton, when depressed momentarily, initiates testing for approximately 45 seconds. During this 45-second interval, the Function Switch can be used to select any position (except the SELF TEST). When a new position has been selected, the test results will appear on the Display.

Note that after the Function Switch is placed in the SELF TEST position, testing is discontinued and the Model 4130 is effectively turned off. The Display will be blank. It is then necessary to depress and hold down the PUSH TO TEST Pushbutton to allow the self-test function to run.

2-3.2.3 Display. The LED Display contains 5 digits that indicate the numeric data resulting from the test measurements. On the right portion of the Display, there are 3 indicators (MHz, WATTS and VSWR). See Figure 2-1. Depending on the type of data displayed, one or more of these will light, except for relative field strength where none will light. The types of data are:

(a) MHz. Resulting from the frequency measurement.

(b) WATTS. Resulting from either the forward RF power or reflected RF power measurement.

(c) VSWR. The voltage standing wave ratio.

When the PUSH TO TEST Pushbutton is depressed regardless of the Function Switch setting, the entire Display:

(a) Remains off for 2 seconds

(b) Then the MHz, WATTS and VSWR indicators blink for 3 seconds.

During the self-test function, the following indications will also occur:

(a) The entire Display (.8.8.8.8.8 and the MHz, WATTS and VSWR indicators) will light for 3 seconds.

(b) Battery voltage will be displayed between dashes, such as -7.92- or -8.14-.

2-3.2.4 RADIO/ANTENNA Connectors. The RADIO and ANTENNA Connectors are BNC types used to connect the Model 4130 "in-line" between the radio being tested and its associated antenna or dummy load. The connectors are used for the following measurements:

(a) RF forward power.

(b) RF reflected power.

(c) VSWR.

(d) Frequency of the RF signal transmitted.

(e) Receiver sensitivity, selectivity, and receive frequency.

2-3.2.5 Field Strength Antenna. The Field Strength Antenna, located in the upper right-hand portion of the Front Panel, receives a transmitted signal. This signal is monitored during the relative field strength (FLD STR) measurement function. See Par. 2-3.2.6, Relative FIELD STRENGTH SENSITIVITY Adjustment.

2-3.2.6 Relative FIELD STRENGTH SENSITIVITY Adjustment. The relative FIELD STRENGTH Adjustment is used during the measurement of the relative field strength of an RF transmission.

This adjustment compensates for the wide variation in field strengths received by the Field Strength Antenna. It is a "gain control" for the received signal. While receiving the signal and before peaking the transmitter-to-antenna coupling of the transmitter, this adjustment should be set for a display of about 50. (This is the mid-range of the possible reading, since it can vary from 0 to 100 when the Model 4130 is measuring field strength.)

2-4 BASIC CIRCUIT DESCRIPTION. A Basic Block Diagram of the Model 4130 is shown in Figure 2-2. All testing activities are controlled by the Microcomputer which receives information from the following sources:

(a) Front Panel Switches; direct the tests to be performed.

(b) Analog to Digital Converter; supplies the measurement data for all tests except frequency and receiver sensitivity, selectivity and receive frequency.

(c) Digital Divider; used during frequency measurement.

The Microcomputer, after receiving measurement data and instructions, sends the results to the Display. The FM Spectrum Generator produces the calibrated output signals at even 5 MHz frequencies from 30 to 90 MHz for use during receiver sensitivity checks. These signals are input directly to the RF Coupler section located between the RADIO and ANTENNA Connectors.

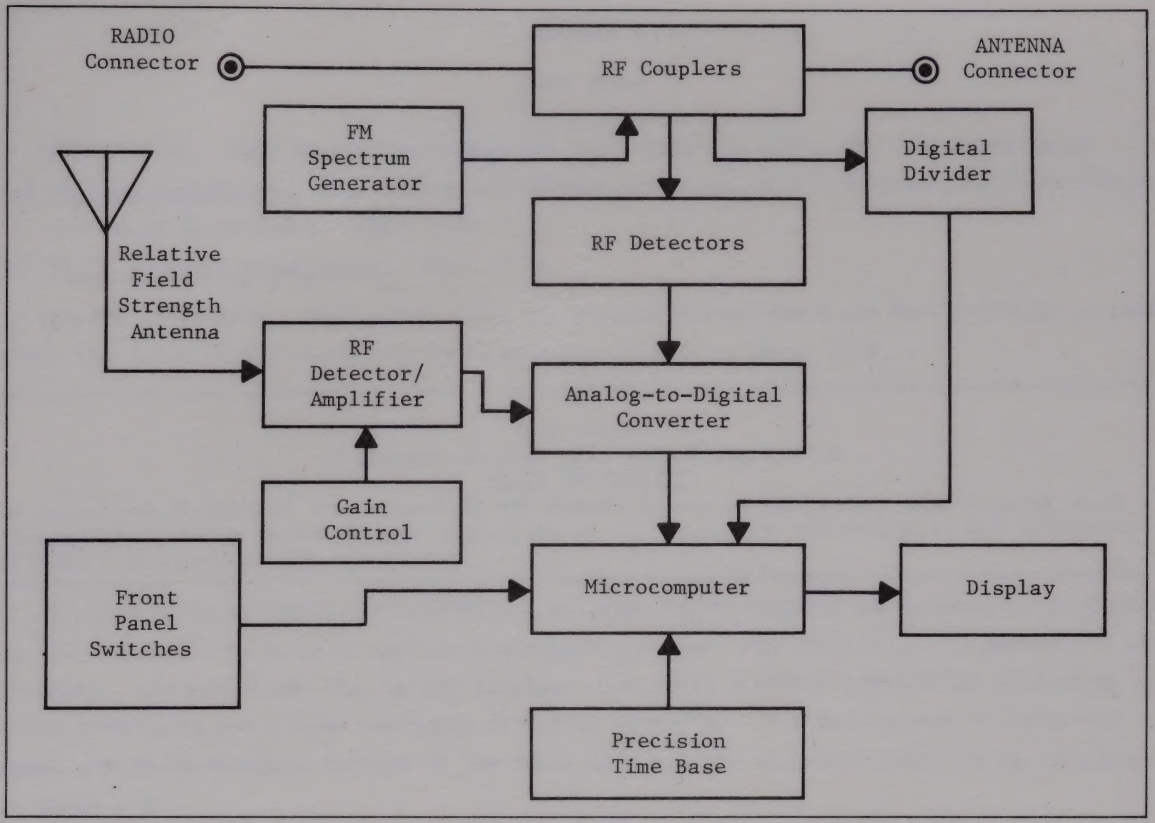

Figure 2-2 Model 4130 Basic Block Diagram

CHAPTER 3

TEST SETUP

3-1 INTRODUCTION. This Section describes the test setup for the Model 4130 as follows:

(a) In-line connection. Used during the forward power and reflected power, VSWR, frequency and sensitivity tests. (Par. 3-2)

(b) Field strength measurement. (Par. 3-3)

3-2 IN-LINE CONNECTION. Figure 3-1 shows the in-line hookup where the Model 4130 is connected between the radio being tested and its associated antenna or dummy load.

WARNING

HIGH VOLTAGE
is present on the radio sets being tested.
DEATH ON CONTACT
or injury may result if personnel fail to observe safety precautions. Remove power from the equipment being tested before connecting or disconnecting the cables to the RADIO and ANTENNA Connectors of the Model 4130.

3-3 RELATIVE FIELD STRENGTH MEASUREMENT. A relative field strength measurement is performed when the Function Switch is in the field strength position (FLD STR/SENS). It provides a relative number, between 0 and 100, on the Display. The FIELD STRENGTH SENSITIVITY Adjustment is used to compensate for a wide variation in signal strengths. For this reason the distance between the Field Strength Antenna of the Model 4130 and the hand-held radio is not critical. See Figure 3-2

Note: position the Field Strength Antenna to its upright position when performing a relative field strength measurement.

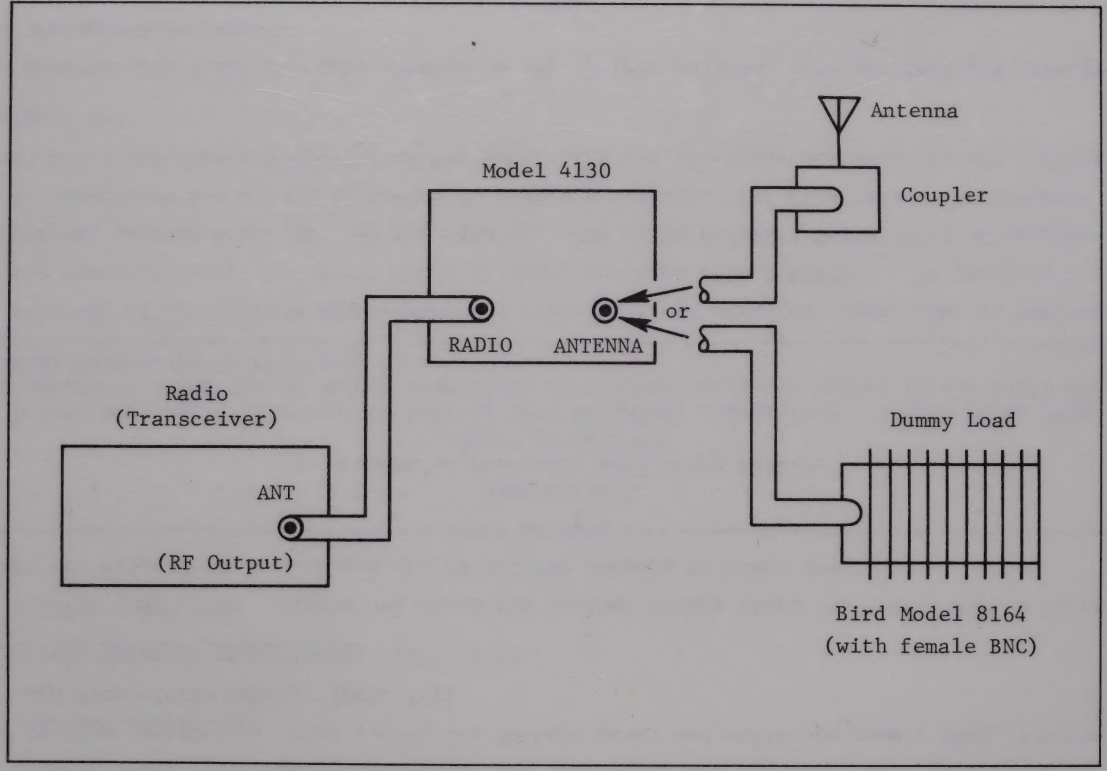

Figure 3-1 In-Line Connection

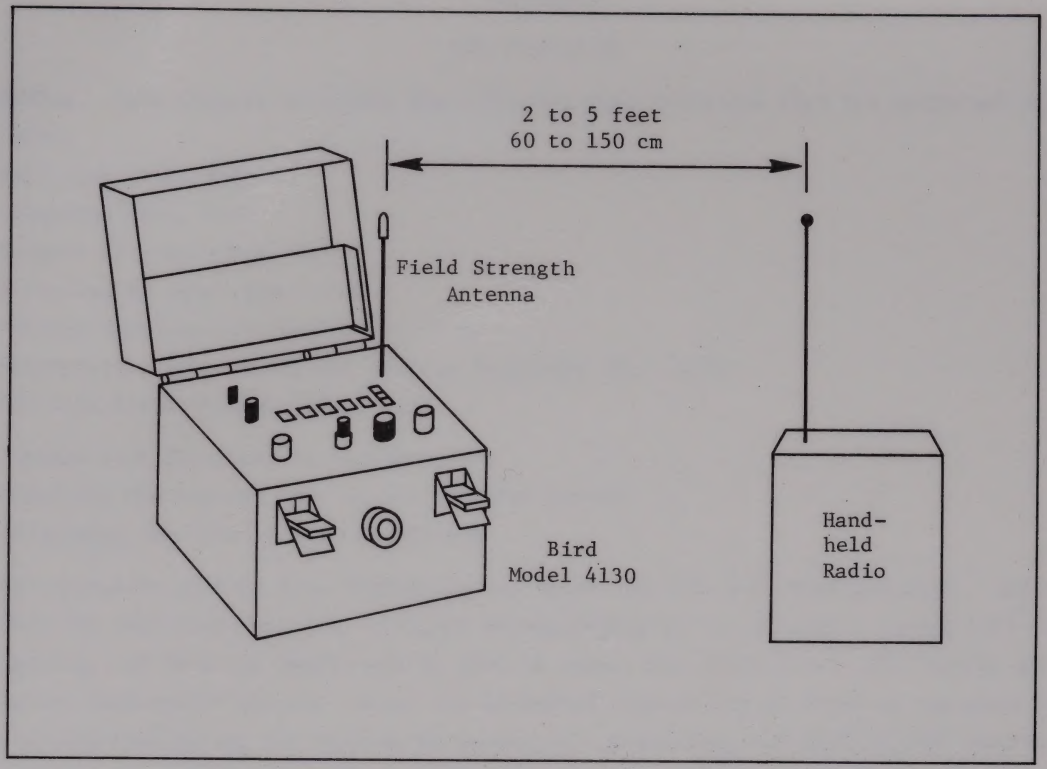

Figure 3-2 Relative Field Strength Measurement

CHAPTER 4

TEST FUNCTIONS

4-1 GENERAL. This Chapter describes the following test functions that are performed with the Model 4130.

(a) Self test (Par. 4-2)

(b) Frequency (Par. 4-3)

(c) Forward RF power (Par. 4-4)

(d) Reflected RF power (Par. 4-5)

(e) Voltage standing wave ratio (Par. 4-6)

(f) Sensitivity, selectivity and receive frequency (Par. 4-7)

(g) Relative field strength (Par. 4-8)

Each of these test functions is initiated by:

(a) Selecting the desired test on the Function Switch

(b) Depressing the PUSH TO TEST Pushbutton

It is not necessary to hold this Pushbutton in, except for the self-test function. All tests, except for the self-test function, continue automatically for 45 seconds. During this 45-second period, the Function Switch can be used to select any other test. The Display will then show the new measurement values. Also, the 45-second timeout can be reset to continue for 45 seconds at any time during the testing by momentarily depressing the PUSH TO TEST Pushbutton. Note: selecting the self-test function will abort testing. To run the self test, it is necessary to depress and hold the PUSH TO TEST Pushbutton.

WARNING

HIGH VOLTAGE
is present on the radio sets being tested.
DEATH ON CONTACT
or injury may result if personnel fail to observe safety precautions. Remove power from the equipment being tested before connecting or disconnecting the cables to the RADIO and ANTENNA Connectors of the Model 4130.

CAUTION

If either of the following error messages occurs:

- E-1, RF power greater than 120 watts;
- E-2, reflected power greater than or equal to forward power. (The ANTENNA and RADIO connections are probably reversed.)

STOP TRANSMITTING IMMEDIATELY
Equipment failure of the Model 4130 and/or the radio set being tested can occur.

4-2 SELF TEST FUNCTION. The self-test function verifies that the majority of the circuitry contained on the Model 4130 is working properly and then displays the unit's Battery voltage. Always run the self-test function before performing any measurement functions with the Model 4130.

To run the self-test function, first disconnect the Model 4130. Perform the following:

(a) Select the SELF TEST position of the Function Switch.

(b) Depress and hold the PUSH TO TEST Pushbutton.

(c) Monitor the Display, and refer to Table 4-1.

The last 3-digit number, bracketed in dashes, appearing on the Display indicates the actual Battery voltage. This number will remain as long as the PUSH TO TEST Pushbutton is depressed. The remaining operating lifetime of the Battery can be determined from Table 4-2. Note: when

Table 4-1

Self Test Indications

Display condition	Indication
Normal (Model 4130 OK)	• First, there is a 2-second delay. • Second, MHz, WATTS and VSWR Indicators, located on the right portion of the Display, will blink for 3 seconds. • Third, the number .8.8.8.8.8 and the MHz, WATTS and VSWR Indicators will be on for 3 seconds. • Fourth, the Display will indicate the current Battery voltage bracketed in dashes. The MHz, WATTS and VSWR Indicators will remain on. See Table 4-2.
Malfunction (Model 4130 malfunctioning)	If any or all of the numbers or Indicators do not illuminate normally, assume a malfunction. The unit should be repaired.
Moving decimal	If the decimal point moves from left to right across the Display, the Battery voltage is low. This can be a normal condition, even for a new Battery. Also, a nearly dead Battery will operate the Model 4130 in modes other than self test for some time. See Chapter 5 for details and replacement.

Table 4-2

Voltage Level vs. Operating Time

Battery voltage	Remaining operating time (hours/minutes) [1]			
	-20°C	-10°C	0°C	25°C to 50°C
8.10	[2]	[2]	[2]	3/15
7.95	[2]	[2]	4/30	1/45
7.80	[2]	[2]	2/45	1/00
7.65	4/00 [3]	6/00	1/45	0/40
7.50	2/45	2/30	1/00	0/25
Total hours [4]	16	17	20	21

[1] Approximate operating time varies with temperature as noted.

[2] At temperatures listed, these voltages will probably never occur.

[3] Four hours or more.

[4] Approximate; assumes a new Battery is installed.

the Battery voltage is too low to operate the Model 4130, a decimal point will move from left to right across the Display. (This indication overrides the test function.)

4-3 FREQUENCY (FREQ) TEST. The frequency test function measures the frequency of the RF signal generated by a transmitter. The frequency, in megahertz, appears on the Display. Perform the following steps to measure frequency:

(a) Connect the Model 4130 in the transmission line between the transmitter and antenna or dummy load, as shown in Figure 3-1.

(b) Select the frequency position (FREQ) on the Function Switch.

(d) Depress the PUSH TO TEST Pushbutton momentarily. When the transmitter is keyed, the frequency measurement in megahertz will appear on the Display. (If less than 0.5 watts is being transmitted, the error message E-5 will be alternately displayed with the frequency measurement data.)

Note: after depressing the PUSH TO TEST Pushbutton momentarily, testing continues for 45 seconds. The 45-second timeout can be reset to continue for 45 seconds at any time during the testing by momentarily depressing the PUSH TO TEST Pushbutton. During this time other test functions can be selected. Selecting SELF TEST, however, discontinues other testing.

Table 4-3 lists the Display indications of the frequency test function.

4-4 FORWARD POWER (FWD) TEST. The forward power test function measures the forward RF power output of the radio set being tested. The power in watts appears on the Display. Perform the following steps to measure forward power:

(a) Connect the Model 4130 in the transmission line between the transmitter and the antenna or dummy load, as shown in Figure 3-1.

Table 4-3

Frequency Test Indications

Display condition	Description
30.000 to 90.000 MHz	30.000 to 90.000 MHz will be displayed with ±0.002 MHz accuracy.
Error conditions E-1 thru E-6	If E-1 or E-2 are displayed, STOP TRANSMITTING IMMEDIATELY. See Chapter 7 for a description of error codes.
Moving decimal point	If a decimal point moves from left to right across the Display, the Battery could need replacement. See Chapter 5 for details and replacement.

(b) Select the forward power (FWD) position on the Function Switch.

(c) Depress the PUSH TO TEST Pushbutton momentarily. When the transmitter is keyed, the forward power measurement in watts will be shown on the Display. (If less than 0.5 watts is being transmitted, the error message E-5 will be alternately displayed with the power measurement data.)

Note: after depressing the PUSH TO TEST Pushbutton momentarily, testing continues for 45 seconds. The 45-second timeout can be reset to continue for 45 seconds at any time during the testing by momentarily depressing the PUSH TO TEST Pushbutton. During this time other test functions can be selected. Selecting SELF TEST, however, discontinues other testing.

Table 4-4 lists the Display indications of the forward power test function.

Table 4-4

Forward Power Test Indications

Display conditions	Description
0.50 to 100 watts	0.50 to 100 watts will be displayed with an accuracy of ±10%. [1]
Error conditions E-1 thru E-6	If E-1 or E-2 are displayed, STOP TRANSMITTING IMMEDIATELY. See Chapter 7 for a description of error codes.
Moving decimal point	If a decimal point moves from left to right across the Display, the Battery could need replacement. See Chapter 5 for details and replacement.
[1] The frequency of the transmission must be within the range of 30 to 90 MHz. See specifications, Table 6-1.	

4-5 REFLECTED POWER (RFL) TEST. The reflected power test function measures the RF power which is "reflected" (that is, not radiated) by the antenna as a result of transmission line-to-antenna impedance mismatch. When the antenna is tuned for the maximum radiation of power, the reflected power will be small compared to the forward power.

4-5.1 Reflected Power Considerations. Some practical considerations on reflected power follow:

(a) Power. The larger the forward power is, the larger the reflected power will be, assuming other factors such as the transmission line-to-antenna impedance match remain unchanged.

(b) Frequency. The transmission line-to-antenna impedance match varies with frequency. Normally, when using a tuned antenna such as the AS-1729/VRC, the reflected power should be

10% or less of the value of the forward power. If, for example, the forward power is 60 watts, the reflected power should be 6 watts or less.

4-5.2 Reflected Power Test. Perform the following steps to measure the reflected power:

(a) Connect the Model 4130 in the transmission line between the transmitter and antenna or dummy load, as shown in Figure 3-1.

(b) Select the reflected power (RFL) position of the Function Switch.

(c) Depress the PUSH TO TEST Pushbutton momentarily. When the transmitter is keyed, the reflected power measurement in watts will be shown on the Display.

Note: after depressing the PUSH TO TEST Pushbutton momentarily, testing continues for 45 seconds. The 45-second timeout can be reset to continue for 45 seconds at any time during the testing by momentarily depressing the PUSH TO TEST Pushbutton. During this time other test functions can be selected. Selecting SELF TEST, however, discontinues other testing.

Table 4-5 lists the Display indications of the reflected power measurement.

4-6 VOLTAGE STANDING WAVE RATIO (VSWR) TEST. The voltage standing wave ratio (VSWR) test function displays the VSWR that is calculated by the Model 4130.

4-6.1 VSWR Considerations. The VSWR calculation performed by the Model 4130, using the reflected and forward power measurements, is based on the following:

$$VSWR = \frac{\sqrt{FWD\ PWR} + \sqrt{RFL\ PWR}}{\sqrt{FWD\ PWR} - \sqrt{RFL\ PWR}}$$

The VSWR displayed will be:

(a) 1.00, if the antenna is ideally matched to the transmission line.

Table 4-5

Reflected Power Test Indications

Display conditions	Description
0.50 to 100 watts	0.50 to 100 watts will be displayed with an accuracy of $\pm(10\% + \frac{\text{FWD PWR}}{400})$. [1]
Error conditions E-1 thru E-6	If E-1 or E-2 are displayed, STOP TRANSMITTING IMMEDIATELY. Note: if forward power is adequate, then the E-5 condition indicates a desirable condition: the reflected power is below 0.5 watts. See Chapter 7 for a description of error codes.
Moving decimal point	If a decimal point moves from left to right across the Display, the Battery could need replacement. See Chapter 5 for details and replacement.
[1] The frequency of the transmission must be within the range of 30 to 90 MHz. See specifications, Table 6-1.	

(b) A number larger than 1.00, where the antenna is not matched perfectly to the transmission line.

Normally the VSWR will vary between 1.00 and 2.00 when using a tuned antenna such as the AS-1729-VRC.

4-6.2 VSWR Test. Perform the following steps to measure VSWR:

(a) Connect the Model 4130 in the transmission line between the transmitter and antenna or dummy load, as shown in Figure 3-1.

(b) Select the voltage standing wave ratio (VSWR) position of the Function Switch.

(c) Depress the PUSH TO TEST Pushbutton momentarily. When the transmitter is keyed, the VSWR measurement will be shown on the Display.

Note: after depressing the PUSH TO TEST Pushbutton momentarily, testing continues for 45 seconds. The 45-second timeout can be reset to continue for 45 seconds at any time during the testing by momentarily depressing the PUSH TO TEST Pushbutton. During this time other test functions can be selected. Selecting SELF TEST, however, discontinues other testing.

Table 4-6 lists the Display indications of the VSWR test function.

4-7 SENSITIVITY (SENS) TEST. The sensitivity (SENS) test function provides a means to measure the sensitivity, selectivity, and receive frequency calibration of an FM receiver. A group of 13 calibrated FM signals, each 0.45 ($\pm$0.15) microvolt in amplitude and simultaneously frequency-modulated with both 150 Hz and 1 kHz tones, are generated by the Model 4130 for these tests. The frequencies are: 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85 and 90 MHz. The purpose of the 150 Hz and 1 kHz tones follows:

(a) 150 Hz tone. The 150 Hz tone is used to unsquelch certain receivers, such as the AN/PRC-77, AN/PRC-68, or the AN/PRC-12 series equipped with "new squelch." Note: receivers not equipped with new squelch rely upon "old squelch" where RF carrier detection is used for unsquelching. The terms old and new squelch are used with receivers equipped with the 150 Hz new squelch. A receiver selector switch is used to select the old squelch or new squelch operation.

(b) 1 kHz tone. The 1 kHz tone is used for audible detection by the operator during these

Table 4-6

VSWR Test Indications

Display conditions	Description
1.00 to 100	1.00 to 100 will be displayed. The accuracy is dependent on the accuracy of the forward and reflected power measurements only. See specifications, Table 6-1.
100.PL	100.PL (for 100 Plus) will be displayed when the VSWR is calculated to be greater than 100. This occurs (in particular) when the forward and reflected powers are both equal even if both are zero, such as when the transmitter is not keyed or connected to the Model 4130.
Error conditions	If E-1 or E-2 are displayed, STOP TRANSMITTING IMMEDIATELY. Note: if forward power is adequate, then the E-5 condition indicates a desirable condition: the reflected power is below 0.5 watts. See Chapter 7 for a description of error codes.
Moving decimal point	If a decimal point moves from left to right across the Display, the Battery could need replacement. See Chapter 5 for details and replacement.

tests. When the receiver unsquelches, this tone should be heard regardless of the type of squelch (old or new) selected.

Two procedures are listed next, one for checking sensitivity (Par. 4-7.1) and another to check the receive frequency and selectivity (Par. 4-7.2). They are listed in the recommended order for an AN/VRC-12 series receiver. Other receiver types may be more easily checked following a different order. Keep in mind that the results obtained from these checks are often interde-

pendent. Par. 4-7.3 describes how to interpret data obtained from these checks.

4-7.1 Sensitivity Check. Receiver sensitivity is checked as follows:

(a) Connect the Model 4130 in the transmission line between the radio set and an appropriate dummy load, as shown in Figure 3-1. Use of the antenna in place of the dummy load may cause problems with the test if other radiated signals are received by the antenna during the test.

(b) Select the sensitivity (FLD STR/SENS) position of the Function Switch.

(c) Depress the PUSH TO TEST Pushbutton momentarily to generate the FM signals.

(d) Perform the following checks as indicated:

(1) Squelch off (old squelch off for receivers with new squelch). The 1 kHz tone should be heard at each even 5 MHz frequency from 30.000 to 90.000 MHz across the receive band.

(2) Squelch on (old squelch on for receivers with new squelch). The receiver should unsquelch and the 1 kHz tone should be heard at each even 5 MHz frequency from 30.000 to 90.000 MHz across the receive band.

(3) New squelch off (for receivers with new squelch only). The 1 kHz tone should be heard at each even 5 MHz frequency from 30.000 to 90.000 MHz across the receive band.

(4) New squelch on (for receivers with new squelch only). The receiver should unsquelch and the 1 kHz tone should be heard at 75 MHz. The receiver may or may not unsquelch at other even 5 MHz frequencies across the receive band. Whenever the receiver does unsquelch, the 1 kHz tone should be heard.

4-7.2 Receive Frequency and Selectivity Check. The frequency accuracy of the receiver and the selectivity of the receiver can be checked using the following procedure:

(a) Connect the Model 4130 in the transmission line between the radio set and an appropriate dummy load, as shown in Figure 3-1. Use of the antenna in place of the dummy load may cause problems with the test if radiated signals are received by the antenna during the test.

(b) Select the sensitivity (FLD STR/SENS) position of the Function Switch.

(c) Depress the PUSH TO TEST Pushbutton momentarily to generate the FM signals.

(d) Set the receiver squelch off. Note: either squelch off or old squelch off or new squelch off.

(e) Select an even 5 MHz frequency (such as 30.000 or 35.000 MHz) and perform the following checks while listening for the 1 kHz audible tone:

(1) Tune the receiver in the smallest increments possible (50 kHz for AN/VRC-12 series) above the even 5 MHz frequency until the audible tone is no longer heard. Note the frequency. The tone should not be heard when 25 kHz above the even 5 MHz frequency.

(2) Tune the receiver below the even 5 MHz frequency until the audible tone is no longer heard. Note the frequency. The tone should not be heard when 25 kHz below the 5 MHz frequency.

(f) Repeat step (e) for each even 5 MHz frequency possible in the receive band of the radio set being tested.

4-7.3 Using Test Data. The data obtained from the sensitivity and frequency and selectivity checks described in Paragraphs 4-7.1 and 4-7.2 can be used to pinpoint malfunctions in radio sets. This Paragraph lists typical data and resulting conclusions which can be obtained.

(a) Incorrect frequency calibration. If the 1 kHz tone is heard near one or more of the even 5 MHz settings of the receiver, but these settings are offset from the even 5 MHz frequencies, then receive frequency of the radio set is out of calibration.

Example: the tone is heard at 30.05 and 35.05 MHz rather than 30.00 and 35.00 MHz.

(b) Poor receiver selectivity. If the 1 kHz tone is heard over a range of more than 50 kHz at one or more of the even 5 MHz frequencies, then the receiver selecitvity is bad.

Example: the tone is heard at 30.00 and 30.05 MHz or 34.95 and 35.00 MHz.

(c) Incorrect frequency calibration and poor selectivity. When both conditions (a) and (b) listed above occur at the same time, the receive frequency and the selectivity are both deficient.

4-8 RELATIVE FIELD STRENGTH (FLD STR) TEST. The relative field strength test function provides a relative measurement of a transmitted RF signal. The Field Strength Antenna of the Model 4130 receives the signal, and the Display provides a relative indication of the signal from 0 to 100. This indication can be used as a relative measure of field strength to adjust the coupling to hand-held receiver antennas.

Perform the following steps to measure relative field strength:

(a) Position the radio set and Model 4130 as shown in Figure 4-1.
(b) Insure that the Field Strength Antenna is in the upright position.
(c) Select the FLD STR/SENS position of the Function Switch.
(d) Depress the PUSH TO TEST Pushbutton momentarily.

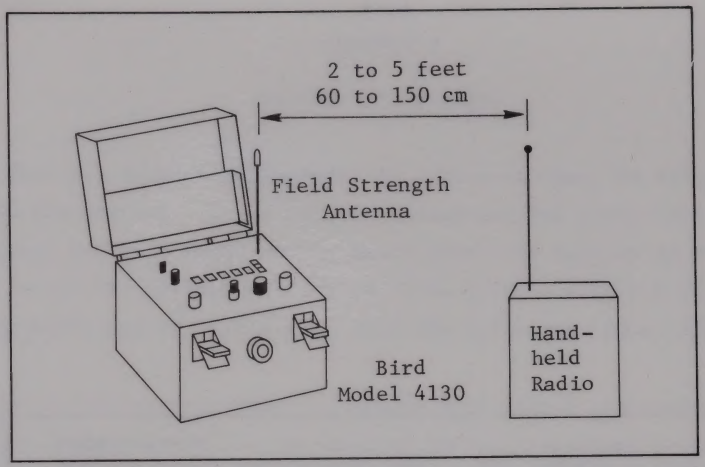

Figure 4-1 Relative Field Strength Measurement

(e) When the transmitter is keyed, the Display will indicate some number between 0 and 100. At this time adjust the FIELD STRENGTH SENSITIVITY Adjustment so the Display reads mid-range (about 50).

While monitoring the Display, the transmitter-to-antenna coupling can be adjusted for the maximum relative power measurement. Note: positioning of the operator's hands during measurement and adjustment will affect the readings.

Note: after depressing the PUSH TO TEST Pushbutton momentarily, testing continues for 45 seconds. The 45-second timeout can be reset to continue for 45 seconds at any time during the

testing by momentarily depressing the PUSH TO TEST Pushbutton. During this time other test functions can be selected. Selecting SELF TEST, however, discontinues other testing.

Table 4-7 lists the Display indications of the relative field strength (FLD STR) test function.

Table 4-7

Relative Field Strength Test Indications

Display conditions	Description
0 to 100	0 to 100 will be displayed when a transmitted RF signal is being received by the Field Strength Antenna.
Low Battery	If a decimal point moves from left to right across the Display, the Battery could need replacement. See Chapter 5 for details and replacement.

CHAPTER 5

BATTERY REPLACEMENT

5-1 GENERAL. The need for Battery replacement is indicated when the decimal point moves from left to right across the Display. A low Battery indication can occur when a test is being performed. If it does, testing cannot be continued until the Battery is replaced. Note: in the self-test function if the decimal point moves from left to right, a few minutes of operational time in other modes may be available. Keep the following items in mind when replacing the Battery.

WARNING

Personnel can be seriously injured if the lithium Battery contained in the Model 4130 is not handled and disposed of properly. Always observe the following guidelines:

- Dispose of the Battery properly: never burn, crush or incinerate.
- Never attempt to recharge the Battery.
- Never bypass the fuse.
- If the Battery vents gas or becomes hot, stop operating the equipment. Do not handle the Battery until it cools and stops venting.

CAUTION

Lithium batteries not used for periods of a few weeks or more or subjected to low temperatures for several hours or more, whether contained in the Model 4130 or not, may appear to be dead or discharged. This is a characteristic of lithium batteries. Simply place the Function Switch in the SELF TEST position and depress the PUSH TO TEST Pushbutton for 30 seconds. If the battery contains a useable charge, it will operate normally after this time. Failure to observe this caution can result in unnecessary Battery replacement.

5-2 REPLACEMENT PARTS. The part numbers for the Battery and Desiccant are listed in Table 5-1. The Desiccant consists of a small pouch containing chemicals used to absorb moisture. It must be replaced whenever the Front Panel is removed.

Table 5-1

Replacement Parts

Item	Bird Part No.	U.S. Federal Stock No.
Battery	5-1444	6135-01-069-8575
Desiccant	5-1443	6850-00-264-6568

5-3 BATTERY REPLACEMENT. The following procedure describes how to replace the Battery:

(a) Remove the 12 screws securing the Front Panel to the Instrument Case. See Figure 5-1.

(b) Carefully lift the Front Panel, along with its associated components, out of the Instrument Case and set it face down next to the Case.

(c) Unplug the in-line Connector on the 2 wires running between the Battery and the circuitry.

(d) Remove the 4 screws securing the Battery Cover to the bottom of the Instrument Case.

(e) Remove the Battery from the Battery Case.

(f) Unplug the keyed connector from the Battery.

(g) Reinstall the Battery by following the reverse order of steps (a) thru (f).

(h) Replace the old Desiccant pouch with the new Desiccant pouch.

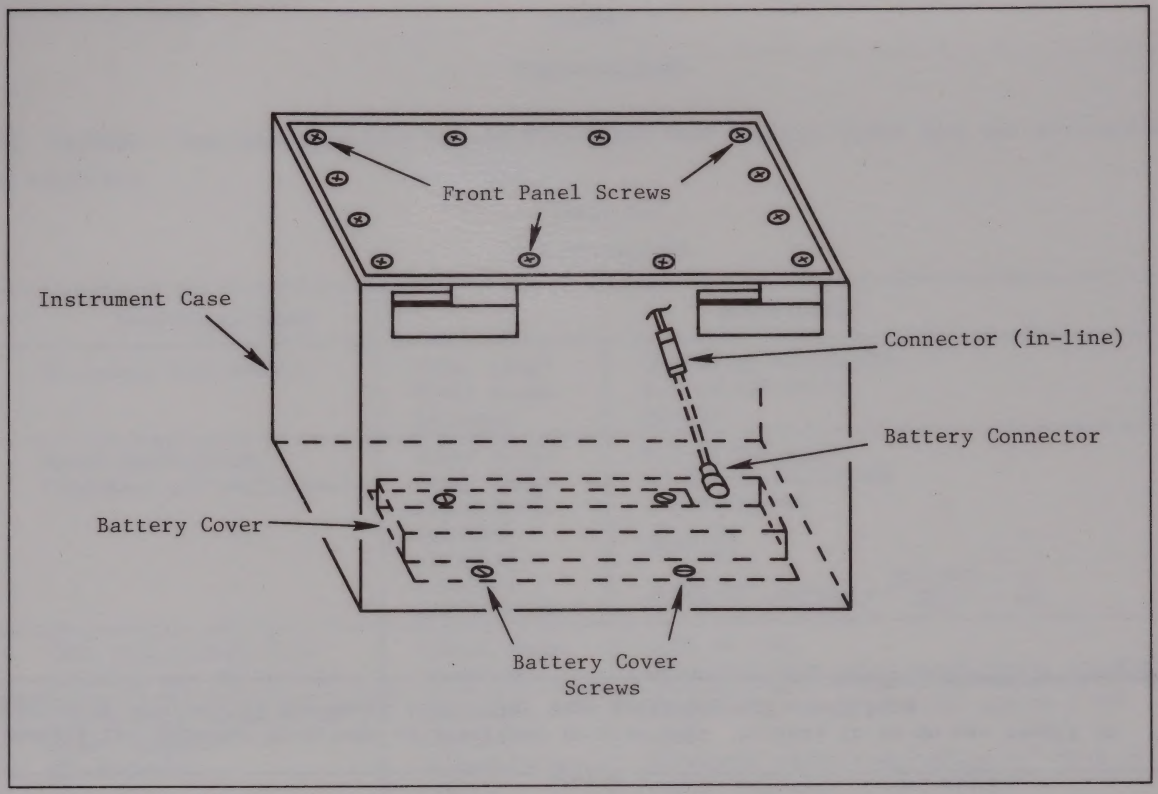

Figure 5-1 Instrument Case (rear view)

CAUTION

Use only the special sealing screws supplied to fasten the Battery Cover and Front Panel. Use of other screws can result in equipment damage due to the loss of watertight integrity.

NOTICE

Install the approved Desiccant as described in step (h). Failure to do so can result in decreased accuracy of the Model 4130 under some environmental conditions.

CHAPTER 6

SPECIFICATIONS

6-1 GENERAL. The specifications for the Bird Model 4130 Tactical Radio Test Set are contained in Table 6-1.

Table 6-1

Specifications

Functional item	Description	
Frequency measurement	Freq. range Power range Accuracy	30.000 to 90.000 MHz 0.5 to 100 watts ±2 kHz
Power measurement (incident and reflected)	Power range Freq. range Directivity Accuracy (forward) Accuracy (reflected)	0.5 to 100 watts 30.000 to 90.000 MHz 26 dB minimum ±10% [1] $\pm$(10% of reading + $\frac{\text{FWD PWR}}{400}$) [1]
VSWR (calculated from incident and reflected)	Result range Accuracy	1.00 to 100. Dependent upon power measurement accuracy
Sensitivity function FM output signals (13 signals)	Frequency of signals FM modulation 1 kHz FM modulation 150 Hz Signal level	From 30.000 to 90.000 MHz spaced 5 MHz apart Resultant carrier deviation for each of the 13 signals: 2 kHz minimum Resultant carrier deviation at 75 MHz: 3.25 kHz (±0.7 kHz) 0.45 microvolt (±0.15 microvolt)

Table 6-1 (con't.)

Functional item	Description	
Relative field strength function	Displays a relative reading of field strength from 0 to 100. (Approximate adjustment range is 30 dB.)	
Self test function	Verifies operation of the majority of the circuitry contained in the Model 4130.	
Antenna line section (applies to frequency, POWER, VSWR and sensitivity functions)	Impedance Insertion VSWR Insertion loss	50 ohms 1.05 (-32.2 dB return loss) maximum Less than 1% (-0.0436 dB)
Dimensions (approximate)	H·W·D	7 x 8 x 8 in. (17.8 x 20.3 x 20.3 cm)
Weight (approximate)	8 lbs. (3.5 kg) including Operator's Manual and 1 meter RF Power Cable	
Temperature range (operational)	-20° to +50°C (-4° to +122°F)	

[1] Small amounts of AM, up to 10%, are tolerable. However, every 1% of AM can decrease the accuracy by 1%. Use of the Model 4130 with RF signals amplitude modulated above 10% is not recommended because of the resulting inaccuracies.

CHAPTER 7

ERROR CODES/LOW BATTERY INDICATIONS

7-1 INTRODUCTION. This Chapter lists and describes:

(a) Error codes (Par. 7-2)

(b) Low Battery indications (Par. 7-3)

7-2 ERROR CODES. Error codes E-1 thru E-6 are displayed in response to conditions detected internally by the Model 4130. Table 7-1 lists each error code.

CAUTION

If either of the following error messages occurs:

- E-1, RF power greater than 120 watts;
- E-2, reflected power greater than or equal to forward power. (The ANTENNA and RADIO connections are probably reversed.)

STOP TRANSMITTING IMMEDIATELY

Equipment failure of the Model 4130 and/or the radio set being tested can occur.

7-3 LOW BATTERY. A low Battery condition will stop normal testing functions and cause the decimal point to move from left to right across the Display. During the self-test function, the actual Battery voltage is displayed. By referencing the voltage to Table 4-2, the approximate operating time left can be determined. See Paragraph 4-2.

Table 7-1

Error Codes

Code	Description
E-1	RF power has exceeded 120 watts. Stop transmitting immediately. [1]
E-2	Reflected power greater than or equal to forward power. (RADIO and ANTENNA cable connections to the Model 4130 are probably reversed.) Stop transmitting immediately. Note: the E-2 code will only be displayed when either or both the forward and reflected power is equal to or greater than 0.5 watts.
E-3 [2]	RF signal frequency is above 90 MHz.
E-4 [2]	RF signal frequency is below 30 MHz. [3]
E-5 [2]	RF power is below 0.5 watts. [4]
E-6 [2]	RF power has exceeded 100 watts

[1] Damage to the Model 4130 will not result unless power levels above 120 watts occur.

[2] With errors E-3 thru E-6, the Display will alternately display the error code and the data.

[3] When RF power is not being generated or a transmitter is not connected to the Model 4130, the error message E-4 will be displayed alternately with 0 data while performing forward power, reflected power or VSWR test.

[4] When RF power is not being generated or a transmitter is not connected to the Model 4130, the error message E-5 will be displayed alternately with 0 data while performing a frequency test.

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